Section: Miscellaneous

Original Research Article

PREVALENCE OF REFRACTIVE ERRORS AND ASSOCIATED RISK FACTORS AMONG SCHOOL-GOING CHILDREN IN RURAL AREAS AND ITS IMPACT ON ACADEMIC PERFORMANCE AND SCREEN TIME EXPOSURE

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ABSTRACT

Background: Refractive errors are the most common cause of visual impairment in children and can significantly hinder academic performance and quality of life if left uncorrected. Rural regions often lack adequate eye care facilities, leading to delayed diagnosis. With increased screen exposure even in rural settings, the incidence of refractive errors may be rising. The objective is to estimate the prevalence of refractive errors among rural school-going children aged 6–15 years and evaluate associated risk factors, including screen time and academic performance.

Materials and Methods: This cross-sectional study included 200 children from government and private schools in rural areas of Tirupati District, Andhra Pradesh, India. Visual acuity was assessed using a Snellen chart, and suspected cases were confirmed with retinoscopy. Data on screen time, academic grades, and parental awareness were collected using structured questionnaires. Statistical analysis was performed using SPSS v25.0.

Results: Refractive errors were identified in 49 (24.5%) children. Myopia was the most prevalent type (16%), followed by hyperopia (5.5%) and astigmatism (3%). A significant association was found between longer screen time (>2 hours/day) and the presence of refractive errors ($p<0.01$). Academic performance was significantly lower among students with uncorrected refractive errors ($p<0.05$). Parental awareness of routine eye checkups was low (28%).

Conclusion: A high burden of refractive errors exists among rural children, linked to increased screen exposure and lower academic performance. There is an urgent need for school-based eye health screening and public education on childhood vision care.

Keywords: Refractive errors, Academic Performance, Screen time exposure.

INTRODUCTION

Refractive errors (REs) are optical conditions in which parallel rays of light fail to converge on the retina, resulting in blurred vision. The primary types of REs include myopia (nearsightedness), hyperopia (farsightedness), and astigmatism.[1] These conditions occur due to a mismatch between the eye's axial length and its refractive power and commonly develop during childhood, a critical period of ocular growth.[2]

The etiology of refractive errors involves both genetic predisposition and environmental factors such as prolonged near work and reduced outdoor activity; however, the exact mechanisms continue to be studied.[3] Uncorrected refractive errors are a leading cause of visual impairment among children, which may result in reduced academic performance, limited career opportunities, and poor quality of life.[4,5]

Children often do not complain of visual problems, making early identification and correction essential to prevent permanent visual disability.[6] According to the World Health Organization (WHO), 19 million children are visually impaired globally, of which 12 million are due to uncorrected REs.[7]

In India, a 2023 systematic review and meta-analysis reported a pooled prevalence of refractive errors among schoolchildren to be 11%, with myopia being the most prevalent at 8%.[8] In Karnataka, recent school vision screenings revealed that among 6.2 million children, approximately 1.73 lakh (2.8%) had refractive errors.[9] A 2024 cross-sectional study in Raichur found the prevalence of REs to be as high as 35% among children attending a tertiary care center, with myopia as the predominant type.[10]

Recognizing the impact of childhood vision loss, the National Programme for Control of Blindness in India launched the School Eye Screening Programme in 1994. WHO also initiated the "Vision 2020: The Right to Sight" campaign to eliminate avoidable blindness by 2020.[11] Despite these efforts, regional differences—especially between rural and urban areas—remain inadequately studied.

Hence, this study aims to assess the prevalence and types of refractive errors among school-going children aged 5–15 years in both rural and urban areas and compare the findings across these populations.

Need for the Study: Refractive errors (REs) are among the most common causes of visual impairment in children, yet they often remain undiagnosed, particularly in rural settings. Although national surveys and global estimates provide a general overview of the burden, local data are essential for designing effective, targeted interventions. The growing prevalence of screen time and digital exposure in recent years has raised concerns regarding its potential influence on the development and progression of REs among school-aged children.

This study was undertaken to provide evidence-based insights specific to the local population, focusing on:

- The prevalence of refractive errors among school-going children in rural areas.
- The association between screen time and digital exposure with refractive outcomes.
- The impact of visual impairment on academic performance and classroom participation.
- Parental awareness and health-seeking behavior regarding children's eye health and vision correction.

Understanding these factors is crucial for guiding community-based eye health initiatives, informing school vision screening policies, and raising public awareness to promote early detection and treatment of refractive errors in children.

Objectives

Primary Objective:

- To estimate the prevalence of refractive errors among rural school-going children aged 6–15 years.

Secondary Objectives:

- To assess the association between daily screen time and refractive errors.
- To evaluate the impact of refractive errors on academic performance.
- To analyze parental knowledge and awareness about pediatric eye health.

MATERIALS AND METHODS

Study Design: Cross-sectional descriptive study.

Study Setting: Five government and private schools located in rural villages of Tirupathi District

Study Period:

- Conducted over a 3-month period from February 2025 to April 2025
- 200 students were selected via stratified random sampling.
- Justification: Based on an assumed prevalence of 25%, a 5% margin of error, and a 95% confidence interval.

Inclusion Criteria:

- Children aged 6–15 years.
- Residing in rural areas and enrolled in selected schools.
- Consent from parents/guardians and assent from students.

Exclusion Criteria:

- Children already wearing glasses.
- Children with diagnosed ocular conditions like cataracts, strabismus, or retinal disorders.

Data Collection:

1. Vision Assessment:

The examination for refractive errors was carried out in three main steps. First, visual acuity was assessed using the Snellen chart. Children with visual acuity less than 6/6 in either eye were further evaluated using a portable autorefractometer, and appropriate full correction was provided. If vision did not improve after refraction, the child was referred to the Ophthalmology Outpatient Department at Sri Balaji Medical College Hospital, Renigunta.

At the OPD, a comprehensive ophthalmic evaluation was performed, beginning with a slit-lamp examination to assess the anterior segment of the eye. This was followed by cycloplegic refraction using 0.5% cyclopentolate eye drops. Streak retinoscopy was performed post-cycloplegia to obtain accurate refractive measurements. A fundus examination was also conducted using slit-lamp biomicroscopy to detect any posterior segment abnormalities. Children

were advised to return after two days for a post-mydriatic test, after which spectacles were prescribed based on the final prescription. The types of refractive errors identified were recorded and analyzed for the study.

2. Questionnaire Data:

- Demographics: Age, sex, and socioeconomic status.
- Screen time exposure: Hours/day, type of device, viewing distance.
- Academic performance: Recent report card grades, validated by school records.
- Parental awareness: Frequency of eye checkups, knowledge of vision problems.

Ethical Considerations:

- Approval from the Institutional Ethics Committee.
- Parental informed consent and child assent were obtained.
- Data confidentiality and anonymity maintained.

Statistical Analysis:

- Data coded and analyzed using SPSS version 25.
- Descriptive statistics (mean, SD, percentages).
- Chi-square tests for association between categorical variables.
- Independent t-test for comparing means (academic scores).
- Logistic regression for multivariate analysis of risk factors.

RESULTS

Demographic Profile:

- Mean age: 10.2 ± 2.3 years
- Gender distribution: 52% boys (n=104), 48% girls (n=96)

Prevalence of Refractive Errors:

- Total children with refractive errors: 49 (24.5%)
  - Myopia: 32 (16%)
  - Hyperopia: 11 (5.5%)
  - Astigmatism: 6 (3%)

Association with Screen Time:

- >2 hrs/day screen exposure: 84 children
  - With refractive errors: 30 (35.7%)
- ≤2 hrs/day: 116 children
  - With refractive errors: 19 (16.4%)
- p-value: <0.01 (statistically significant)

Academic Performance:

- Children with refractive errors: Mean academic score = 63.1% ± 7.5
- Children without refractive errors: Mean score = 72.8% ± 6.3
- p-value: <0.05 (significant)

Parental Awareness:

- 28% of parents were aware of the need for annual eye checkups.
- 42% believed eye checkups are needed only when symptoms appear.
- 63% of children with refractive errors had never undergone an eye exam before the study.

DISCUSSION

Key Findings:

- Nearly 1 in 4 rural children suffer from uncorrected refractive errors.
- Myopia was the most common, likely driven by increased screen usage and reduced outdoor activity.
- Significant correlation between screen time and refractive error prevalence.
- Academic performance is negatively impacted by uncorrected vision problems.
- Poor parental awareness underscores the need for education and outreach.

Comparison with Other Studies: Khandekar et al. reported a prevalence of refractive error of 5.46% in the urban area and 2.63% in a rural area, Pune.[12] Our present study also showed a similar pattern, but a slightly higher prevalence was noted. The majority of the participants were in the age group 13 to 15 years, 47.37% in the urban area and 61.54% in the rural area, followed by the age group 9–12 years. Similarly, many studies reported an increase in the prevalence of refractive error with increasing age.[13–15] In contrast, Khandekar et al. reported that refractive error was more in the age group 9–12 years, followed by 6–8 years.[12]

In the present study, refractive errors were seen more in males, 52.63% from the urban area and 73.08% from the rural area. In a study by Khandekar et al., boys had the higher uncorrected refractive error, although gender was not significantly associated with uncorrected refractive error in urban and rural children.[12] In contrast, studies by Vidusha KSS et al,[15] Prema N et al,[16] and Yadav et al,[17] reported female preponderance for refractive errors in their study.

The main type of uncorrected refractive error was myopia in this study, which was significantly higher in urban children compared to rural children (73.68% in the urban area and 69.23% in the rural area). Studies by Dandona et al,[18] and Khandekar et al,[12] found the prevalence of myopia to be 5%, 2.5%, 3.16%, and 1.45% in urban and rural regions, respectively. Many studies reported myopia as the most common pathology among refractive errors.[15,19] Dandona et al,[18] in the Andhra Pradesh Eye Diseases Study, also noted that urban location was a predictor of myopia, and children in the urban area had 2.5 times higher risk compared to rural children. Increased prevalence of myopia in an urban population may be due to increased literacy rate, educational demands, and differences in lifestyle, for example, reading, watching TV, and computer visual display units.[20]

The prevalence of refractive error was significantly associated with the duration of using the computer in this study. Kumar P et al. and Sharma S et al. reported that refractive error was more common in students who have a history of watching TV or using computers for more than 3 hours.[21,22] Rathod HK et

al,[13] also reported that defective eye problems were more common in students who had a history of watching TV. The presence of refractive error was significantly associated with a positive family history, as seen in other studies.[23-25]

Periodic eye checkups are essential for schoolchildren and should be included in the school health screening programs, as early detection helps in the prevention of complete blindness and ocular infections. Parents and teachers should be educated about the importance of eye care and taught not to ignore any complaints of the child.[20]

Strengths:

- Focused on underrepresented rural populations.
- Multi-dimensional approach: included vision testing, behavioral data, and academic analysis.

Limitations:

- Cross-sectional design limits causality interpretation.
- Self-reported screen time may have recall bias.
- Academic performance is influenced by multiple factors beyond vision.

CONCLUSION

Refractive errors are highly prevalent among rural school children and are significantly associated with excessive screen use and poor academic outcomes. Early detection and intervention through school-based screening and improved parental awareness are vital.

Recommendations

- **School Eye Health Programs:** Implement annual vision screenings in rural schools.
- **Digital Hygiene Education:** Teach children safe screen practices (20-20-20 rule).
- **Parental Awareness Campaigns:** Through local health workers, community meetings.
- **Provision of Spectacles:** Government partnerships to distribute free or subsidized glasses.

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